very fleshy. The catamenial discharge had returned and was now regular.

This case could not have been one of extra-uterine conception, for the early history of the case together with the discharge of the soft parts and bones per vaginam, prove incontestibly that it was uterine, even if the operation had not demonstrated the fact. Neither can it be believed that there had been rupture of the uterus at any period during the progress of this case, for when the bones were removed they were firmly enclosed in the uterus, and there was no other opening but the passage externally, for which we think there is little difficulty in accounting. The pressure of the bones against the walls of the uterus, produced inflammation and suppuration, which, passing by continuity of surface to the parietes of the abdomen occasioned the aperture. The inflammation thus excited also produced adhesion between the uterus and abdominal parietes, which union must still exist—indeed, when I last examined her, the parietes of the abdomen were considerably drawn in by this attachment.

Believing this case to be of considerable interest to the medical world, and besides, one of rare occurrence,* I have been induced to submit it for publication.

Hampton, Elizabeth City County, Va. Feb. 1830.

ART. III. *Examination of the Nature and Effects of Malaria, and on the Pathology and Treatment of Malarial Fevers.* By EDWIN D. FAUST, M. D. of Columbia, S. C.

THE subject to which we would call the attention of our readers, has been long patiently and ingeniously examined; but the results of such examinations have not satisfied the philosophical minds of modern physicians. The importance of the subject is every where known, and has excited, in all enlightened countries, a spirit of inquiry, which will finally result in successful discovery, but which has not yet procured us that kind of knowledge, on which alone, practical conclusions can be safely founded. The causes which have retarded the

* The only case I have met with at all similar to the foregoing, is one recorded by Dr. Müller, and noticed in the number of the American Journal of the Medical Sciences, for August, 1829. Owing to some accident, this number of the Journal did not reach me until some weeks after the removal of the bones in this case. In Dr. M.'s case the fœtus was expelled at the umbilicus by the natural efforts of the uterus.

progress of discovery in this most interesting department of medical science, are probably numerous, and it would be a difficult task to detect them all. In some cases, the views of observers have been too limited, as regards the kinds of knowledge employed in their researches, or the number and value of the facts from which they have formed their opinions. Others have been misled by attaching themselves to some favourite hypothesis, neglecting all facts not easily reconcileable with their doctrine, and magnifying, in their own conceits, all those from which they have expected support.

In a paper, the object of which is to ascertain truth as it is, and not to establish a merely ingenious hypothesis, we shall attempt to release ourselves from the influence of our own prejudices, to examine candidly some of the doctrines concerning the nature and influence of malaria, to show in what points they are deficient, and to explain those views which appear to us most consistent with the phenomena which have been observed, and most likely to lead to sound practical conclusions. It will be seen that the elementary views on which our doctrine is based are not new; but that those elements have been sometimes examined in a new spirit, and have been placed in new relations with one another. From this, we hope to offer definite ideas on the present subject, and to lay the foundation for fixed principles on collateral questions.

It seems to be pretty well determined, that the production of that volatile poison of which we are treating, depends, always, upon the co-existence of warmth, moisture, and decaying vegetable matter. In those cases in which remittent and intermittent fevers occur in districts not plainly showing the sources of malaria, we may always conclude that there is a sub-soil which prevents the percolation of water, or some other source of an analogous nature.* This source has been known for many centuries; and, as Dr. Caldwell remarks, is evidently referred to by Homer.† In Lucretius, also, we have the influence of an atmosphere poisoned by malaria, forcibly set forth.‡ It might be contended that these cases referred to a cause different from that of remittent and intermittent fever, because, in both instances, domestic animals are said to have suffered, and in the former they are made to precede man in the catastrophe. We are yet, however, to learn, whether lyssa and other epidemic and contagious diseases among domestic animals, do not result from the influence of

* First American Edition of Gregory's Theory and Practice, vol. 1, p. 120.

† Illiad, Book I. line 43.

‡ De Rer. Nat. Liber VI. 1217; or the Lucrèce de Pongerville, Tom. 2, p. 410; for a different version, see Good's Study of Medicine, 1825, Vol. 2, p. 49.

malaria, acting upon a peculiar and temporary state of the system of these animals. A remarkable case in point is detailed by the eminent Larrey, in his observations on a violent inflammatory fever which occurred among the cows and oxen, during the campaign of Italy, affecting also the health of the inhabitants, and which dissection showed to be an intense gastro-enteritis. Speaking of the causes of this epidemic, he says, "Les renseignemens que je recueillie auprès des habitans, les recherches aux quelles je me livrai, m'assurèrent que l'épizootie reconnaissait, pour principales causes, la mauvaise qualité des fourages, l'état marécageux des pâturages, la chaleur excessive et prolongée qui avait succédé tout-a-coup à un printemps pluvieux et orageux. Les pluies d'orage avaient considérablement grossi les torrens, les rivières, et en avaient causé le débordement: une partie de ces eaux, après avoir nui aux récoltes, était restée en stagnation dans les lieux bas et enfoncés, ce qui avait formé autant de marécages."*

To the moderns, however, we owe our present views on the subject, and Lancisi appears to be the original writer.† For the establishment of our views, it will be necessary to bring before our readers, some of the most important characters of malaria, as determined by the best authorities, and to show that these characters are inconsistent with some of the doctrines which have been or may be advanced.

The evidence offered by Dr. Macculloch, to show that malaria adheres to solids, is, we think, by no means conclusive; but we allow the fact, and shall show that even this, if granted, is not fatal to our views.‡

It obeys the motions of the atmosphere, and is generally, if not always, combined with water, in the form of mist.§

The rays of the sun disperse it.‖

Fire and smoke prevent its effects; not as Macculloch suggests in pages 292 and 293, but as we shall hereafter explain, and as he seems, from page 285, to have faintly conceived.

It causes fever. The varieties in the kinds of fever produced by the malaria of different situations, do not show any difference in the

* Memoires de Chirurgie Militaire, tom. 1, p. 165.

† De noxiis paludum effluviis, 1717, as quoted by Gregory, vol. 1, p. 118, first American edition.

‡ Malaria: an Essay on the Production and Propagation of this Poison, &c. London, 1827, p. 267 and 268.

§ Macculloch, p. 259 and 311.

‖ Macculloch, p. 276, or Caldwell's Translation of Alibert, 1807, p. 172.

malaria; at least they do not demonstrate it; for the relative proportions of moisture and gas, the climate, season, constitution and mode of life of the patients, together with other circumstances, will, perhaps, explain all these phenomena.

The poison has been supposed to be intercepted by a gauze veil; but of this there is no satisfactory evidence.*

It follows currents of air; occupying the lower regions of the atmosphere, and not rising to the height of a few hundred feet, unless raised by a strong breeze, or by the sun.†

It is supposed to be intercepted by groves in which the foliage is thick.‡ Houses are thought to have the same effect; that side of a street, nearest a marsh, being usually considered most sickly.§

It acts most powerfully before the rising and after the setting of the sun; the presence of which disperses or decomposes it, or both.‖

Malaria may be considered as an uncombined gas,¶ as the vapour of a volatile solid or liquid, as animalcular,** or as a gas combined with water.

Its characters differ widely from those of uncombined gases. It is known to every chemist, that whenever any gas is allowed to escape into the air, however great may be its specific gravity, it speedily and uniformly diffuses itself through the mass of air, not occupying any particular region.†† This is the case, even with gases which do not combine; as is seen in mixing carbonic acid and hydrogen gases; the mixture remaining uniform, notwithstanding the great difference in the specific gravities of the two substances.‡‡ The proportion of carbonic acid in the atmosphere of mountains, is the same as in that of vallies.§§ It will follow then, that, as gases, in an uncombined state, mingle, in opposition to the laws of gravity, while malaria occupies the lower strata of the atmosphere, and is with difficulty dif-

* Macculloch, p. 299.

† Caldwell's Translation of Alibert on Malignant Intermittents, p. 175, or Macculloch, p. 265.

‡ Macculloch, p. 247, 252.

§ Baglivi, Opera Omnia, p. 157, 158, as quoted in Bancroft's Treatise on Yellow Fever, p. 165.

‖ Caldwell's Alibert, p. 172, 173, or Macculloch, p. 276.

¶ Volta's idea; see Macculloch, p. 421.

** American Quarterly Review, for Dec. 1828, p. 303.

†† Thomson's Chemistry, 1818, Vol. III. p. 34; Webster's Manual of Chemistry, 1826, p. 165.

‡‡ Thomson, Vol. III. p. 33; carbonic acid is 22 times heavier than hydrogen.

§§ Turner's Chemistry, first Amer. edit. 1828, p. 146.

fused, unless by strong winds, malaria cannot be consistently viewed as an uncombined gas.

The vapours of very volatile solids and liquids, as camphor, musk, ether, &c. follow the same law of uniform diffusion as gases, and have therefore no stronger claim to be considered as constituting malaria, than the latter class of substances.

The doctrine of the animalcular nature of malaria, which is of ancient origin, and has met with support from some more modern writers, does not appear to us to present stronger evidences in its favour than the former hypotheses. It merits, however, a particular consideration. The localities from which malaria emanates, are such as may be expected to generate animalculæ; but the same situations are the invariable and inexhaustible sources of carburetted hydrogen, carbonic acid, and other gases. The argument of co-existence, therefore, as applied to the defence of this doctrine, goes for nothing; being equally applicable to other agents, of well known deleterious character. But allowing animalculæ to be produced in marshy situations, it must be remembered that they are generated in water, or in contact with moist soil, or vegetable matter, to which, on account of their extreme minuteness, they must be closely attached by this moisture. Under these circumstances, it will be mechanically impossible for the atmosphere to remove them from the places in which they were formed; and they must, of course, die and decay, without ever mingling with the air. This very obvious and simple objection is fatal to the hypothesis, as it stands at present, and the supporters of the doctrine will be driven to the necessity of endowing the animalculæ with wings; a position which could not be reasonably assumed.

Malaria remains near the ground, and obeys the lower currents of air; but solids so minute and light as to float in a calm atmosphere will not remain near the surface, but will mingle with the mass of air, in the same way as uncombined gases with one another, from the simple facts that no portion of the atmosphere ever retains its position for two minutes together, and that these solids obey the slightest possible impulse. Any current of air sufficient to detach animalculæ from even a dry soil, must disperse them so as to prevent their deleterious influence, while a very weak impulse, such as propagates malaria, must fail to raise them from the moist matter to which they adhere. The radiated heat of a fire, smoke, and probably other chemical agents, neutralize the effects of malaria; in what way we shall consider hereafter. But it is well known that the lower classes of animals resist, in a surprising degree, the want of

pure air, and the presence of deleterious matter, such as the irrespirable gases, even in a concentrated state; and still more in the very diluted form here supposed, in which these agents must be harmless to insects.

Malaria seems to be interrupted by a row of houses, so that fever is more common on the side of a street nearest a marsh, than on the opposite side. But if malaria consist of air holding in suspension animalculæ, it is evident that the poison would have such free access to the more remote side, through the spaces between the houses, and by the cross streets, as well as by other accidental and various avenues as to infect completely both sides, and prevent the occurrence of any perceptible difference. We shall show hereafter, that the same objection does not apply to our views.

Malaria is dispersed, if not decomposed, by the sun; but we cannot snppose that animalculæ are in any way affected by a temperature high enough to support all animal life, yet not even so high as that of the places in which they were generated. The moist soil in which animalculæ were produced, will always be more heated by the rays of the sun, than the atmosphere, or minute bodies floating in the open space to which the wind has free access.

All these facts seem to us inconsistent with the hypothesis now under consideration; and we shall violate the principles of philosophy if we reject opinions founded on indisputable facts, and supported by the strongest probabilities, for others founded on a supposed existence of animals not proved to exist, not appreciated by our senses, and not proved, even granting their existence, to possess the properties attributed to them. The most malignant fever may be excited by a few hours exposure to a very concentrated malaria. How then can it be conceived, that the atmosphere should be so loaded with animalculæ, as to act violently and rapidly on the system, producing the most intense inflammations and dangerous congestions of the internal organs, and yet, the animals so fatally abnndant remain invisible, intangible, tasteless, and inodorous: it is impossible. If the animalculæ be so extremely numerous as in these cases they must be, then they will necessarily be visibly accumulated on the skin, and on surrounding substances; the mucous membrane of the lungs and nose will detain them in snch qnantity as to excite cough, if not complete bronchitis. Nothing of this kind occurs. The matter of malaria works its fatal ravages invisible as air. The living fibre shrinks from its touch, and the blood seeks refuge, as it were, in the vital organs; but no external trace is left after its action, or perceived during its application, except the slight contraction of the cutaneous fibre, and

a diminished activity of the capillary circulation; a condition precisely opposite to the effects of all known insects. There is no example in nature, of the production of fever from the poison of any insect externally applied, without previous acute inflammation of the skin. In all these cases the external application of the poison results in a direct external irritation, of which the gastro-enteritis, (fever,) is a consequence. The whole series of phenomena, in the case of malaria, is opposite. *If there be any cutaneous irritation, it is slight and evanescent, and it is only when the vital actions of the surface languish, that we find the development of constitutional disease.**

Are we told that the animalculæ are swallowed with the saliva? It is a frail argument, because the fact is not proved; and because, if the saliva could be so saturated with animalculæ as to become poisonous, then would the poison itself be visible, and change the properties of the fluid: this has not been seen. In another point of view, the assertion is of no value. In passing through the towns of Italy, the traveller is especially cautioned to sleep as little as possible, in the malarial districts, as sleep is found to be favourable to the reception of fever in such situations. The reader will remember, unfortunately for the animalcular doctrine, that during sleep the secretion of saliva is diminished,† and less is swallowed than in the waking state. On this ground sleep might be considered prudent in persons exposed to malaria; but the contrary is the case. We must not, too, overlook the fact, that during sleep the mouth is usually closed, and the air passes to the lungs without coming in contact with the saliva, and therefore without contaminating it. The well established fact above alluded to, is then inconsistent with the hypothesis under consideration. Let us see whether it does not lend support to the views which we have adopted. It is known to every physiologist, that during sleep, the cutaneous circulation is languid,‡ while there is an accumulation of blood in the internal organs; indeed, that the latter state is one of the first steps to the ordinary occurrence of sleep.§ This determination predisposes, so long as it continues, to internal inflammation and congestion; and this predisposition is the

* The influence of malaria in depressing the vitality of the surface, is illustrated by Dr. Daniell, of Savannah, in his work on fever; but this ingenious author has erred in supposing the digestive surface to partake of the cutaneous atony. Those who have heard the learned and valuable lectures of Dr. Geddings of Charleston, will recognise the above doctrine.

† Broussais's Physiology, 1826, p. 156.

‡ Op. Cit. p. 157.

§ Op. Cit. p. 151, 154.

more easily converted into actual disease, because the actions of the skin are, in this languid state, more readily suspended by the malaria, than in the more active condition of wakefulness.* We have thus a satisfactory rationale of the greater liability to fever in the one state than in the other.

Nor does the prevalence of insects always correspond with that of malaria. The abundance of all kinds of insects in Columbia, for some months past, has been remarkable, especially of the smaller species, near the marshes surrounding the town. The mosquitoes did not appear as early as usual, but have been abundant for some time past. Yet among this host of insects none of the poisonous animalculæ have appeared, and the good health of not only Columbia, but also of the greater portion of the state† is now, (November 1st,) and has been for some time almost unparalleled.

Such is the substance of the objections against the doctrines above discussed, which now occur to us. We believe all these doctrines to be inconsistent with well known facts, and we have endeavoured to point out some of those inconsistencies.

We shall now go on to develope our own opinions concerning the nature of malaria; to show that it consists of a chemical combination of carburetted hydrogen and water, which chemists have failed to detect, on account of the imperfections of their tests.

In marshes, and in pools of standing water resting upon mixtures of mud and dead vegetable matter, large quantities of light carburetted hydrogen are formed and disengaged during the warm months. By stirring the mud at the bottom of the stagnant water, bubbles of gas escape, and may be received in inverted jars, floating on the surface, and furnished with funnels of oiled paper, for the more easy reception of the gas.‡ When thus obtained, it is mixed with about $\frac{1}{20}$ of carbonic acid, and about the same quantity of nitrogen.§ This mixture does not materially affect its properties, and the carbonic acid may be removed by washing it with lime water.

Light carburetted hydrogen is tasteless, colourless, and inodorous.‖ It supports neither life nor combustion.¶ When mixed with common air, in proper proportion, it forms an explosive mixture; but if the gas exceed the one-sixth, or be less than the one-twelfth of the whole, the componnd ceases to be explosive. When mixed with rather more than one volnme of oxygen, it is explosive; but not so if the oxygen amount

* Op. Cit. p. 157. † A few of the upper districts excepted.
‡ Thomson's System, Vol. I. p. 209. § Turner's Chemistry, 1828, p. 191.
‖ Thomson's System, Vol. I. p. 210. ¶ Turner's Chemistry, p. 191.

to 2.25 volumes.* When mixed with chlorine, both gases being dry, no action occurs, but if the gases contain water, muriatic acid is formed, and either carbonic acid or carbonic oxide, according to the proportions, is set free.† Its specific gravity is 8, hydrogen being 1.‡ It is soluble in sixty times its volume of water,§ and this property has an important relation to the subject before us, as indicating that it is combined with the water of fogs, and it is even probable that in this rarefied form, in which a given quantity of water exposes so large a surface and is so minutely divided, a larger quantity of gas will be detained, and the union will be more strict. Its combination with the aqueous vapour will explain the fact that it does not rapidly disperse itself in the atmosphere, as is the case with uncombined gases, but rather occupies the lower regions of the atmosphere, until the sun raises it along with the vapour into the upper region.

According to Dr. Beddoes, the blood and muscles of animals killed by confinement in this gas have a red colour, less distinct than that produced by oxygen, but very different from the dark colour exhibited by animals killed by drowning or carbonic acid.‖ There is much obscurity in the reddening of blood by this gas, and there seems to be no error, as Dr. Beddoes speaks very positively of the facts, and mentions some decisive experiments.

The following statement of Sir H. Davy, shows the powerful depressing influence of the gas, when received into the lungs. It will be observed in this case, as in those quoted from Dr. Beddoes, that the gas was obtained from steam and charcoal; that it possessed, when newly made, a strong odour, and that being necessarily impure, it affords only an approximation to the effects of the gas obtained from stagnant water.

* "For this purpose I introduced into a silk bag four quarts of gas, nearly pure, which was carefully produced from the decomposition of water by charcoal, an hour before, and which had a very strong and disagreeable smell.

"My friend, Mr. James Tobin, Jr. being present, after a forced exhaustion of my lungs, the nose being accurately closed, I made three inspirations and expirations of the hydro-carbonate. The first inspiration produced a sort of numbness and loss of feeling in the chest and about the pectoral muscles. After the second inspiration, I lost all power of perceiving external things, and had no distinct sensation, except a terrible oppression on the chest. During the third

* Thomson, Vol. I. p. 210. † Turner, p. 192.

‡ Macneven's Brande, 1826, p. 140. § Turner, p. 191.

‖ Beddoes on Air; the various parts are so badly arranged that we cannot specify pages.

expiration this feeling disappeared; I seemed sinking into annihilation, and had just power enough to drop the mouth-piece from my unclosed lips. A short interval must have passed, during which I respired common air, before the objects about me were distinguishable. On recollecting myself, I faintly articulated, 'I do not think I shall die.' Putting my finger on the wrist, I found my pulse thread-like, and beating with excessive quickness.

"In less than a minute I was able to walk, and the painful oppression on the chest directed me to the open air.

"After making a few steps, which carried me to the garden, my head became giddy, my knees trembled, and I had just sufficient voluntary power to throw myself on the grass. Here the painful feeling of the chest increased with such violence as to threaten suffocation. At this moment I asked for some nitrous oxide. Mr. Dwyer brought me a mixture of oxygen and nitrous oxide, I breathed this for a minute, and believed myself relieved. In five minutes the painful feelings began gradually to diminish. In an hour they had nearly disappeared, and I felt only excessive weakness, and a slight swimming of the head. My voice was very feeble and indistinct. This was at two o'clock in the afternoon.

"I afterwards walked slowly for about half an hour, with Mr. Tobin, Jr. and on my return was so much stronger and better as to believe that the effects of the gas had disappeared, though my pulse was 120 and very feeble. I continued without pain for near three-quarters of an hour, when the giddiness returned* with such violence as to oblige me to lie on the bed; it was accompanied with nausea, loss of memory, and deficient sensation. In about an hour and a half, the giddiness went off, and was succeeded by an excruciating pain in the forehead and between the eyes, with transient pains in the chest and extremities.

"Towards night these affections gradually diminished. At ten no disagreeable feeling except weakness remained. I slept sound, and awoke in the morning very feeble and very hungry. No recurrence of the symptoms took place, and I had nearly recovered my strength by the evening."†

The following cases are mentioned, in other words, by Dr. Beddoes: Mr. Greenwood had used the carburetted hydrogen for about two weeks, in doses of from two pints to five quarts daily, with little effect. The gas was diluted, of course. On the 5th of October he breathed four quarts, diluted; it is not stated to what amount. Ten minutes after this, there was a sense of numbness in the forehead, with heaviness of the eyelids, followed by extreme weakness, and a sense of vacuity in the abdomen. He made an effort to walk a few feet, but was unable to do so. He soon lost all consciousness, for some time, the length of which he could not ascertain. During

* A singular tendency to an intermittent type.

† Sir H. Davy's Researches, Chemical and Philosophical; chiefly concerning nitrous oxide or dephlogisticated nitrous air, and its respiration. London, 1800, p. 468.

this time, there was an involuntary discharge of urine; after which, there was paleness of the face, blue lips, fainting, with extreme weakness for some hours.

A person standing in a current of air while about a cubic foot of the gas was set free, felt, as it passed him, very sensible depression, with vertigo. Another person was thrown into a state of complete syncope, by standing near a tube from which the gas issued for a short time.

The gas prepared from steam and charcoal, is observed to become less active when kept for a few days.* As it is not liable to spontaneous decomposition, this loss of activity is not very easily explained. We cannot imagine that the intelligent practitioners who have prescribed it, would neglect to free it carefully from carbonic acid. As above prepared, it will usually contain some pure hydrogen and carbonic oxide, varying in proportion according to the degree of heat,† yet, as these gases suffer no change on standing, their presence does not explain the phenomenon. Is it not possible that the gas, when newly made, contains a greater quantity of water, than after standfor some time, and that this water enables it to act more powerfully on the system? The subject is at least worth a serious examination. In the process for preparing the gas, it is brought in contact with the heated vapour of water; of course it will unite, under these circumstances, with a considerable quantity of water, a part of which it will deposite on standing. An analogous deposition is often observed by chemists, in saturated solutions which have remained perfectly still for some time. In such cases, crystals subside without the influence of temperature.‡ The subject is obscure, but we are not aware of any other principle on which the fact can be explained.

From the physiological effects of carburetted hydrogen, as above stated, it cannot fail to be observed that it has a powerful influence in determining congestions of the vital organs, with prostration of the muscular powers, and that it leaves, even when applied for but a moment, effects of a striking and by no means evanescent character. Perhaps, indeed, its power of producing internal accumulation of blood will afford the only possible explanation of its effect of reddening the muscles of animals destroyed by it, for it is evident that the gas itself cannot decarbonize the blood. This, however, is not satisfactory to

* Beddoes on Air. † Thomson's System, Vol. I. p. 210.

‡ Thus, on mixing solutions of phosphate of soda and sulphate of magnesia, no immediate effect follows; but after some hours the phosphate of magnesia is deposited in crystals. (Thomson's System, Vol. II. p. 377.)

ourselves, for the venous blood is redder than in cases of death from carbonic acid; and it would thus seem, that the gas interrupts those changes in the parenchymatous structure of the organs by which the arterial fluid is carbonized. The subject, we again confess, is involved in much mystery.

The physiological physician will recognise, in the fulness of the head and heaviness of the eyes, the lividity of the lips and syncope, the vertigo, rapid, thread-like pulse, dizziness, nausea, head-ache, tremor, confusion of mind, pains of the extremities, and excessive muscular debility, many of the most essential symptoms of those gastro-enterites, more or less acute, simple or complicated, which the universal observation of mankind has determined to result from the impression of malaria. To the ontologist, to whom the supposed idiopathic fevers are known as an assemblage of symptoms only, the resemblance may not be sufficiently perfect. For differences in the degree and order of symptoms, we would refer him to the minute detail of any two cases of severe fever, and more particularly to Broussais's case of acute and fatal but apyrectic gastro-enteritis.* To the true pathologist, however, who sees diseases not in the pages of the nosologists only, but in the several organs of the body, the similarity between the effects of carburetted hydrogen and malaria, will be sufficiently evident, and he will not doubt that an atmosphere contaminated by the presence of this gas, can produce effects identical with those observed in fevers.

It has been asserted, that if an atmosphere contain carburetted hydrogen gas, the chemistry of the present day is adequate to its detection. This is undoubtedly true, with respect to mixtures containing a certain proportion of the gas in question; but let us see how it will apply to the examination of malaria. The quantity of carburetted hydrogen contained in any atmosphere, and the proportion requisite for the production of the usual effects, may be fairly considered as very small, probably less than the thousandth part of the whole mass. If, however, it be allowed to constitute so large a proportion as the five-hundredth, it will not, even then, be detected, by any means yet applied to the examination of the atmosphere of marshes; and therefore all the chemical experiments hitherto instituted on the subject, may be considered as having no weight in the present discussion. No axiom in mathematics can be more self-evident, than that carburetted hydrogen must exist in the atmosphere of places in which it is constantly generated in large quantities; yet the chemists have not

* Histoire des Phlegmasies Chroniques, Tome II. p. 479.

detected it. Hence, we see, that whether the gas in question, be malaria, or not, we must look for its detection to a more refined chemistry than has ever been applied to the examination of this subject. Will the chemist attempt to convert the gas into water and carbonic acid, by the electric spark? The properties of the gas will instruct him, that in the diluted form of malaria, the change cannot be effected, by even the most persevering application of this agent. And if be could succeed in effecting the change, the quantity of water and carbonic acid developed would be so very minute, that they would not be appreciable by our tests, unless we should operate on quantities of air larger than our largest receivers would contain, and far greater than any yet examined.

Will it be attempted to decompose it by chlorine? It will be remembered, that the gases, if dry, do not even when concentrated, act on one another. But suppose them to be moist; it is extremely probable, though not verified by actual experiment, that when so largely diluted, no action will occur, and no muriatic acid be liberated. Indeed this probability amounts almost to certainty, when we reflect that even in a concentrated state the action is not very energetic. Allow, however, that in this diluted state, the decomposition should occur; the small portion of muriatic acid formed, being diffused through a large quantity of air, and mixed with chlorine, our tests will not be able to establish its presence; because some uncombined chlorine will necessarily be present, and the tests of muriatic acid are the same as those of chlorine. And even were it possible to establish the presence of a little muriatic acid, no accurate and cautious chemist would feel satisfied that this did not result from the decomposition of aqueous vapour. Nor will it be possible to remove the oxygen and nitrogen of the air under examination, so as to leave the matter of malaria alone; for if we absorb the oxygen by phosphorus, still the nitrogen must remain and mask the poison. When we reflect on all these difficulties, very nearly if not entirely insuperable by the most effectual application of the improved modes of analysis invented since any careful experiments have been instituted on this question, the impartial chemist must confess, that the evidence afforded by his science cannot as yet be entitled to much consideration; nor must the present writer be considered among those most ready to make this concession. After all, we do not despair of the assistance of chemistry in this important and interesting department of science; and we are inclined to believe, that the quantity of poisonous matter sometimes present in the atmosphere of the worst places, in the worst seasons, will be too great to escape the present accurate

tests, under the skilful direction of a THENARD, a HARE, or a SILLIMAN. A fortunate combination of circumstances alone, however, can ever ensure success.

We proceed to some further proofs, that our doctrine is not inconsistent with those properties of malaria which have the most important relation with our subject, and which have been already stated. It must be kept in mind by the reader, that, in obedience to a general law of affinity, water, in the minutely divided form of fog, or more perfect vapour, will unite more freely and easily with carburetted hydrogen, than in its liquid state; but that, in this case, a certain point of rarefaction will reverse the law.

We stated that the evidence on which malaria was supposed to attach itself to solid bodies, was not altogether satisfactory; yet, allowing it to possess this property, it forms no objection to our views; for the observation of every day teaches us, that the watery vapour of the atmosphere is constantly deposited on the various solids with which it meets. This is especially the case with fogs, well known to be the most usual, or even the constant vehicle of the deleterious agent. Hence we might reasonably expect considerable danger from fogs thus impregnated; and observation of facts justifies the opinion.

Malaria obeys the motions of the atmosphere; occupying, however, the lower positions, and not rising to the height of a few hundred feet, unless raised by pretty strong currents of wind, or by the influence of the sun. This corresponds with the vapour in question; and we have already shown that it is inconsistent with any other supposition. Every one has seen fogs of various density pass over extensive tracts of country, without rising above the trees; and where they have free access to any inhabited situation, they have produced fever. Hence the danger of even passing through the lower country of our state, in which the mass of decomposing matter, and therefore the source of carburetted hydrogen, is immense, and the country being low, and the winds obstructed by innumerable forests, the poison accumulates to an alarming degree, and produces the most malignant gastro-enterites.

It is dispersed by the rays of the sun. We have already shown, that this property is not possessed by any of the bodies supposed by others to constitute malaria; but every observer will recognise a very familiar property of aqueous vapour. However abundant the fog may be, it is always dispersed soon after sunrise. The vapour becomes rarefied, and rises into the higher regions of the atmosphere. Hence we may expect fever even on high mountains, when there is an abundant source of malaria in the valley; because the contaminated va-

pour, when rarefied to a certain degree, will rise until the atmosphere becomes too rare to support it, and must then remain stationary until still more expanded. This does occur in various instances; and if it be inquired why it does not happen in every case, we find an explanation in the facts, that the population of such situations is not often great enough to render them remarkable, and the winds are usually strong enough, in high regions, to disperse the contaminated vapour, before it can produce its accustomed effects. To this we may add, that it is highly probable, nay even certain, that the rarefaction of the vapour is often such as to allow even the water to be uniformly dispersed, and the gas to be set free, and come under the laws of uncombined gases. The properties of fogs correspond so precisely with those of malaria, in this respect, that the coincidence might very naturally suggest the probability of the whole of our views.

Fire and smoke prevent the effects of malaria. Dr. Macculloch has suggested that this may occur from the ventilation produced by fire, and the substitution of pure air in place of the contaminated atmosphere. It must be evident, however, that in all such cases, the fire only substitutes one portion of impure air for another; and thus, so far as concerns its ventilating effect, is probably rather a disadvantage than otherwise. As the beams of the sun disperse malaria, so also will fire have the same effect. Under the influence of heat the moisture is expanded, and thus displaced by heavier air. There is no doubt, too, that heat disengages the gas from the water, and thus renders it subject to the laws which govern the mixture of uncombined gases. The effect of heat is, then, precisely what our views would lead us to expect, so far as concerns its effects on malaria. It must be recollected too, that heat keeps up the activity of the cutaneous circulation; an effect in which it directly opposes moisture in a simple state, or in the contaminated form of malaria. The skin, too, being preoccupied by an impression, is less calculated to receive that on which the disease depends. This is a consideration of importance; as we daily apply it to the cure of intermittent gastro-enteritis, (intermittent fever.) As heated air usually accompanies smoke, the same observations will apply to the influence of that agent. In addition to this, however, we must consider, that the acid and other constituents of smoke, may, perhaps, by uniting with the aqueous particles, disengage the gas to which the evil effects are attributable. This, it must be allowed, has not been absolutely demonstrated. The union of smoke with the matter of malaria, must, however, exert a considerable influence, in modifying not only the impression made on the surface, but also the condition of the surface itself, and conse-

quently its capacity for receiving the peculiar morbid change on which depends the subsequent development of gastro-enteritis. These causes will, we think, be quite sufficient to account for the effects; and the phenomena only confirm the doctrine which we advocate, while they invalidate all others.

The interception of malaria by groves, has been quite a mystery to the theorists on this subject, and it is indeed a circumstance not free from obscurity. The animalcular doctrine fails here completely; because animalculæ are not found on the trees as they should be. Their extreme minuteness is no excuse, because every visible body consists of an immense number of invisible particles. This much however is certain; *i. e.* that the greater part of the poison comes in actual contact with the foliage, and is detained or decomposed by it. Now it is a fact familiar to every one, that fogs, in passing through groves, are deposited upon the trees in great quantity; even so as to fall in showers upon the least agitation. The malaria being thus detained, partly penetrates into the leaves and bark, and is partly dispersed by the sun. It is probable, also, that the carburetted hydrogen accompanying the water, is absorbed by the trees, and being decomposed, contributes to their growth, in the same way as carbonic acid. This view appears satisfactory to us, so far as concerns the action of vegetables. Another explanation is necessary in the case of ranges of houses. Allowing the truth of any one of the doctrines of malaria, it must be evident, that the mere mechanical opposition of one side of a street, can never secure the other side, as the cross-streets and other openings, always allow a circulation of air sufficient to produce disease under such circumstances. In Columbia, the streets are one hundred feet wide, and thinly built, with cross streets of the same width. Here then is free access to animalculæ; yet fever is much more common on the side next the river. We have already attempted to account for the influence of smoke and heat; and it will readily occur to the reader, that malaria, after passing the row of houses nearest to a marsh, and depositing a good deal of its substance on the walls of the houses, must encounter, on entering the street, a greater or less quantity of smoke, as well as other accidental and various vapours, *some of which may perhaps have some chemical action on it.* This last part of the proposition, we do not state as decided. In addition to this, it will mingle with warm air, and be heated and rarefied by the caloric passing from pavements and houses, which, by reason of the close situation and constant reflection of heat, have become very warm. We can well conceive, that the combined effects of these causes may diminish the activity of the poison; though, it

must be remembered, that this diminution is limited. If the reader think these causes insufficient, let him consider that the mere mechanical obstacle is not here, as in a grove, sufficiently extensive to account for the effect, and that some cause must exist within the street itself; let him then review what we have already said of the action of heat and smoke, and thence draw his conclusion.

Malaria acts most powerfully before the rising or after the setting of the sun. It is well known that the aqueous vehicle of the carburetted hydrogen is dispersed, if not separated from the poison by the beams of the sun. No other doctrine of malaria can be reconciled with the fact.

Aqueous vapour more or less dense, and united with carburetted hydrogen, as the vapour of marshes must be, being repeatedly applied to the skin and received into the lungs, will depress the capillary circulation of both surfaces. Whether this effect is the result of a directly debilitating influence, or whether the vessels lose their tone by exhaustion from repeated or continued excitement, need not be discussed here. Whenever the malaria is accompanied with a chilly night air, the certainty and violence of the resulting disease are greater;* because there is then a double cause for the suspension of capillary action. If the constitution of an individual be worn down and the actions of the vital organs deteriorated by previous debauch or disease, this interruption of the cutaneous functions will be more easily produced; and as, in such persons, the internal organs have generally been a prey to chronic irritation, the new inflammations are more to be dreaded.

If the quantity of gas in the atmosphere be moderate, the fever resulting from its influence will probably be intermittent or remittent; otherwise, it may assume a continued form. Physiologists have attempted to explain the intermittent character of fever, by the fact that its cause is applied in an intermittent manner, and also that the functions of the organs in health are intermittent.† This certainly goes very far to account for the facts; but it does not seem to us to explain the existence of moderate continued fever, and malignant remittent or intermittent. If malignant intermittent result from the periodical application of a violent cause, what must be the character of the cause which produces a mild remittent, or a moderate continued fever? On this subject we have yet much to learn.

The organs which suffer under the influence of the gaseous poison,

* Macculloch on Malaria, p. 275.

† Goupil: Exposition des principes de la Nouvelle Doctrine Médicale, p. 177.

vary according to circumstances, which are sometimes appreciable, but often very obscure. The mucous membrane of the stomach and small intestines is always inflamed; and in various cases, the large intestines, the liver, brain, and lungs, come into the catalogue of the semiologist, and we have dysenteric, bilious, ataxic, adynamic, and pulmonary complications.* None of these phenomena are contrary to what might be expected from carburetted hydrogen, after a full examination of its effects.

Patients who recover from the immediate violent effects of the agent in question, but remain exposed to its influence, and suffer repeated attacks, finally die of chronic diseases.† The surface, constantly oppressed by the debilitating action of the gas, sinks in the scale of vitality; it becomes pale, with a sallow, unhealthy tinge; its fulness and elasticity are lessened;‡ its secretory power is weakened; and thus the system loses one of its most important depurating organs, the function of which must be supplied by an increased action in the others, and this increased action conduces powerfully to the production of visceral disease.§ The acute irritations of the abdominal viscera do not subside completely in malarial districts, nor in cases treated by emetics and other irritants.‖ When the use of tonics is practised with a view to accelerate convalescence, and strengthen the stomach, the same result occurs. In all these cases, the viscera lose the habit of healthy action; their secretions are vitiated, and become sources of disease; their vessels, always full and heated, exhale fibrin and albumen; thickening their membranes, and interrupting the harmony of their actions.¶ The liver tumefies, becomes sore, and secretes vitiated bile. The spleen enlarges; sometimes to such a size as to become a deformity and a burden.** The stomach excites a thousand unnatural and various symptoms, and disordered digestion constantly torments the individual. To these are added fits of cholera, dysentery, and other consequences of malaria or medicines.†† The sufferings of these organs are not confined to themselves, but extend to the brain, the functions of which are profoundly modified, especially when the uterus has suffered.‡‡ The unnatural condition of

* System der Practischen Heilkunde, von D. C. W. Hufeland; Zweyter Band, p. 5 and 6, Jena, 1818.

† Macculloch, p. 6. ‡ Idem, p. 430.

§ Translation of Broussais's Physiology, first Amer. edit. p. 407.

‖ Broussais's Physiology, p. 327, 328, 329. ¶ Idem.

** Good's Study of Medicine, 1825, vol. 1, p. 279. †† Macculloch, p. 440.

‡‡ De l'Irritation et de la Folie, par F. J. V. Broussais, 1828, p. 336, 337, 338.

this organ excites in distant nerves unusual and painful sensations, which are constantly changing their seat,* and, of course, resist local remedies, while the internal medicines generally used, only pervert, more profoundly, the sensibility of the abdominal organs and encephalon, and perpetuate the evils, which, for a moment, they had seemed to relieve. The brain thus responding to the sufferings of the digestive surface and other tissues, finally extends the excitement of its nervous matter to the capillary vessels, and mechanical lesions occur, which sometimes result in irremediable mania or idiotism.† In other cases, the changes occurring in the brain and spinal marrow, induce paralysis,‡ or convulsive affections; and as the foundation of these complaints is in the digestive surface, the prevalent treatment of cerebral diseases but too often increases the evil, by irritating the stomach already too susceptible of stimulation, and too ready to react upon the nervous system. This reflection of the gastric impressions to the brain, and thence to all the nervous cords, establishes in the latter points of irritation assuming the form of neuralgia. Hence, as Dr. Macculloch has explained, we find neuralgia in malarial districts, associated with or supplying the place of intermittent fever. Whenever this neuralgia is distinctly intermittent, it is very probable that there is a lurking irritation of the stomach; yet there is no evidence that neuralgia from causes entirely local, may not assume an intermittent character. When patients constantly exposed to the action of malaria, are able to support for some time the evil influence of this agent, they finally present the most striking pictures of general derangement of constitution.§ The intellect is weakened; they become hypochondriac, neuropathic, the disposition is soured, the patient is ever complaining, and finally falls a sacrifice to some acute inflammation, or is carried off by dropsy or some of the chronic visceral inflammations known by the English as marasmus. Will any pathologist imagine that these important effects are dependant upon any of the agents to which they are usually attributed? Such causes are not sufficient to explain the effects; but a sufficient cause will be found in the substance, the properties of which have been explained in the preceding pages. We have every reason to believe, that the long-continued impression of this gas, so remarkably deleterious in its effects, will develope the whole train of symptoms which we have but briefly stated. We have already called the

* De l'Irritation et de la Folie, par F. J. V. Broussais, 1828, p. 315.
† Idem, p. 320, or Macculloch, p. 434, 435.
‡ Macculloch, p. 440. § Macculloch, Chapter XI.

attention of the reader to the resemblance between the symptoms produced by carburetted hydrogen, and those met with in the various idiopathic fevers of the ontologists; and this similarity should be considered as an argument in favour of the views which we have defended.

Should our opinions prove correct, they ought to exercise a decided influence on all attempts to prevent the production and diffusion of malaria, and on the preventive discipline to which the individual is to be subjected. There is no doubt that many useful facts on the subject of prevention might have been determined, had more definite ideas prevailed on the chemical nature and physiological action of malaria, and it is not extravagant to hope that we may obtain at some future period comparative security from the effects of an agent which is not now resisted until its poisonous effects have been felt.

After having discussed the comparative merits of the doctrines of malaria, so far as concerns its nature, and briefly noticed its influence on the animal economy, we propose to make some remarks on the means most likely to prove useful in preventing its morbid influence, and to consider the general principles of the treatment of fever, as suggested by its pathology.* The latter subject is at present so much discussed, and will be brought before the American public in so full and able a manner, that our observations need not be extended.

The influence of drainage, and of the preservation of groves between habitations and the sources of malaria, is very generally appreciated. The utility of smoke and fires was understood by Lancisi, and their value was practically illustrated by Napoleon. We quote from Dr. Macculloch, a very striking illustration of the principle:—

"One very pointed case, of a civil nature, is also worth recording, because, while it is always particularly easy to imitate, and has been most unfortunately neglected, the circumstances are such as to interest ourselves, as colonists, under some of our least satisfactory experiments of this nature. In this case, the superintendent engaged in directing the cutting of wood in Africa, erected thirty earthen furnaces on the spot where his men were employed, lighting them every day.

* On this subject we cannot refrain from translating the sentiments of an eminent physician. "In this crisis it seemed to me to be salutary, nay, necessary, to select and fix a certain point, (standpunkt,) in which these various opinions might admit of being united, and employed for practical use, in which the good of all parties might be extracted, with the omission of the useless; the genuine practical results of all times might be received, and the medium kept between fruitless speculation and blind empiricism."—*System der Practischen Heilkunde, von D. C. W. Hufeland. Erster Band, p. viii. Jena,* 1818.

Before this he had always from forty to forty-eight of his workmen sick; when, in a short time, they were reduced to twelve, then to four, and finally to one."*

The same practice modified, of course, according to circumstances, should be used in all cases in which it is practicable. On the same principles may we employ other vapours, such as those of vinegar and other acids, volatile oils, camphor, and in fact any volatile substances capable of producing a decided stimulant impression without irritating too vividly the mucous membrane of the lungs. Such vapours disengaged in houses may have some effect, though it will be limited, and caution will be required to prevent pulmonary disease. These means should be employed less with a view to decompose the malaria, than to preoccupy the cutaneous and pulmonary surfaces, by an impression different from that of the gaseous agent, and thus prevent the production of that condition of the capillaries on which the excitement of fever in a great measure depends. We avail ourselves of a similar principle, in applying bark to the gastric surface, in the treatment of intermittent fever. It would be an interesting research, to ascertain the part played by the Schneiderian membrane in the development of malarial fever. The subject has not yet been examined, but it is possible that the impression made on the olfactory nerves may contribute much to the formation of gastritis. Every one is familiar with the strong and instantaneous irritation developed in the stomach by certain odours; may not the inhalation of malaria, and its consequent action on the nerves, produce more slowly the same effect? It is true that the sense of smell is not affected by malaria, but this is not necessary, for it must be observed that some of the odours which produce the greatest gastric irritation, are extremely faint. The impression made on the nervous extremities, must pass to the brain and be reflected thence before it can reach the stomach,† yet it is not necessary that the mind shall be conscious of the impression which first reaches the brain, and in many cases it perceives only the irritation which the stomach directs to it. Thus, when tobacco is applied to the surface, an irritation reaches the brain without exciting sensation, nor does this occur until the stomach, having received the impression from the brain, returns it in a sensible form. We make these suggestions to show that the subject deserves investigation, for if fever be really communicable in this way, we may take advantage of odorous substances to anticipate the impression.

Another means of modifying the state of the skin, so as to prevent

* Macculloch on Malaria, p. 286.

† Broussais; de l'Irritation et de la Folie, p. 296.

the influence of malaria, will consist in the application of various solids and liquids. Every medical man is familiar with the remarkable influence of oil in procuring immunity from the plague.

"Mr. Tully has informed me, (says Dr. Good,) that there was no instance of an attendant on the infected having received the contagion so long as he was regular in thoroughly illining himself with oil, wearing a dress soaked in oil, or a covering of oil skins."* "To the same effect it has been asserted by Mr. Baldwin of Cairo, that among upwards of a million of inhabitants carried off by the plague in Upper and Lower Egypt, during the space of four years, not a single dealer in oil, so far as he could learn, had fallen a sacrifice to it. A similar remark is made by Mr. Jackson, respecting the crolies or labourers in oil-warehouses, during the Barbary plague just referred to. In that of London, in 1665, it is especially observed by Baynard, and most of the writers, that the trades chiefly exempted were those of oil-men, fishmongers, tanners, bargemen, and watermen, the first three evidently protected by the greasy viscidity that covered the hands and dress generally, and the last two by living separate from the scene of contamination, as though cut off by a quarantine."†

These facts are very remarkable; and it is a matter of surprise that they have been so much neglected. Should experiment demonstrate that malarial fever may be prevented in the same way, the establishment of the fact would be invaluable to persons passing through districts abounding in malaria, or residing, for limited spaces of time, in situations almost certainly fatal. Moderate stimulants and slight astringents, combined with oily substances, might be easily applied, and are worthy of a trial.

Having suggested some prophylactic principles, we go on to make some brief observations on the treatment of the fevers produced by malaria. These observations are founded on the pathology of the diseases, as revealed by post mortem examinations, and on the results of the various plans of practice most in vogue.

All the symptoms in the cold stage of malarial fever, demonstrate the existence of congestion of the encephalic, pectoral, and abdominal viscera, with high irritation, especially in the abdomen.‡ Here, the common practice of administering active stimulants, especially laudanum and ammonia, is highly improper. These substances, if administered before the accession of chill, sometimes produce a diffused excitement, with warmth of the skin and perspiration, and this revulsion may interrupt the chain of morbid actions, and prevent the fit. If, however, this revulsion fail to take place, as often happens, or if the stimulants be given after the formation of the cold stage, the

* Good's Study of Medicine, 1825, Vol. II. p. 439. † Idem, p. 440.
‡ Broussais; Histoire des Phlegmasies chroniques, 1826, Vol. III. p. 335.

irritation of the digestive organs is aggravated, the hot fit is rendered more severe, and the next fit is apt to be more intense. Instead, then, of this uncertain and dangerous treatment, administer internally very gentle diffusible stimulants, such as warm decoctions of orange leaves or sage. To aid these in determining to the surface and destroying the internal congestion, apply warmth extensively to the skin, and use friction, if this can be done without admitting cold air. These agents will lessen the intensity and duration of the congestion, without sensibly increasing the hot stage. In malignant cases in which the congestion is very great, and there is danger of death before the formation of the hot stage, it has been recommended to employ free bleeding from the arm, and cases are detailed, in which this practice interrupted the congestion immediately and saved the lives of the patients.* We cannot speak from experience on this subject, as we have used the lancet but once in the cold stage, and in that case, which was mild, there was no decided effect. Yet, should we ever employ it in malignant cases, it will be with fear and trembling, and with extreme hesitation; for though general bleeding may destroy the congestion, yet it may fail, and in the latter case, the vitality, already alarmingly depressed, may be utterly extinguished. What would be the feelings of the physician, in such a case? The use of tourniquets, and some other means, need not be discussed here.

After the cold stage has passed by, our object is to lessen the violence of the hot fit. As the foundation of a rational practice, we must learn from pathological anatomy, the nature of the disease. This teaches us, that it consists in inflammation of the digestive surface. To this rule, exceptions, if they ever exist, are extremely rare. Irritations of the brain, liver, lungs, and other organs, may or may not exist, at the same time, as effects of external circumstances, or of the gastro-enteritis. If we be told that these lesions are accidental, we appeal to the pathological anatomist for irresistible proof. If it be objected, by those to whom a disease is a set of symptoms, that these phenomena are mere effects of the disease, we reply, that those substances which inflame the stomach, produce all the characteristic symptoms of these diseases; we reply, also, with Roche, the ingenious pupil of Broussais, by asking the ontologists whether heat of the skin, rapidity of the pulse, pains of the limbs, head-ache, thirst, nausea, scanty secretion, &c. redden the mucous membrane, inject its blood-vessels, and produce softening, ulceration, or even

* Amer. Journ. of Med. Sciences, Nov. 1827, p. 227.

perforation?* if not, we cannot agree that this entity, existing in their own minds only, produces all or any of the mischief with which it is so unfairly charged.

Emetics were formerly much in vogue, and are still used by many practitioners. The effect of emetics is, to exalt the vital actions of the digestive membrane and its glandular appendages; and this irritation is evinced by the nausea, the excessive contraction of the muscular fibres of the stomach, and the increased secretion of bile and pancreatic fluid. This last circumstance is the source of a great error in those persons, who, having a bilious taste in the mouth, take an emetic, and vomit large quantities of bile and mucus, the removal of which is set down to the credit of the emetic, while, in reality, it had not been in the stomach before the medicine was taken. Emetics may cure gastric irritation in three ways: first, by exciting free secretions from the diseased surface, thus establishing an artificial crisis; second, by irritating a portion of mucous surface not yet diseased, and thus procuring relief on the same principle of revulsion as in the application of a blister; third, by transferring the irritation to the skin, as is very common, thus inducing critical diaphoresis, or to any other organ, especially of the nervous system, which may chance to be irritable. All these chances, for they can be viewed in no other light, often fail; and when this happens, evil results are almost certain; because the degree of revulsion, will, of course, very rarely balance the irritation of the emetic, so that it shall do neither harm nor good.† A late writer, after defending emetics as one of the best prescriptions in fever, observes, that no intelligent practitioner has failed to see, in the course of his practice, some cases, in which a single emetic has placed the patient beyond the hope of recovery; and the misfortune, he observes, in these cases is, that this fatal result cannot be foreseen. It ought, then, to be a matter of conscience with the practitioner, whether or not he will administer a medicine which sometimes proves fatal, while there is no means of foreseeing, in any case, the result. I know not how he will avoid this objection. In slight or moderate fevers, the revulsion often cures; but in proportion as the gastro-enteritis is more acute, so does the probability of secretion or revulsion to other tissues diminish. All this coincides with the laws of the system, by which membranes cease secreting, when excited to a certain point,‡ and by which all revulsives fail oftener in acute ir-

* Broussais; De l'Irritation et de la Folie, 1828, p. 414.

† Broussais's Physiology; Chapter on Abnormal Assimilation.

‡ Jackson, in Amer. Journ. of Med. Sciences, for Feb. 1828, p. 271.

ritations than in mild cases.* When the inflammation amounts to well-formed and active bilious fever, emetics rarely fail to do evident mischief; this we have repeatedly seen. The most dangerous of those commonly used is emetic tartar, the effect of which is sometimes actually poisonous.† We have seen cases in which it excited the most intense irritability of the stomach, nor are we at a loss for others in which it produced speedy death.‡ The combination of tartar with Epsom or Glauber's salt, is still more to be dreaded; its effect is artificial cholera.§ In short, the effect of emetics is so uncertain and so often unfortunate, especially in serious cases, that they should not be used in fever, unless for some urgent complication, in which warm water should be employed.

In England, and in this country, there is an immense consumption of cathartics; not in fever only, but in all other diseases. We know no exception to this statement. Physicians have been so prodigal in this respect, that every man who feels unwell, resorts, as if by instinct to catharsis; and as we do not generally see patients in the very commencement of their diseases, so do we usually see them after they have been freely purged, if not vomited. Dr. Dickson, of Charleston, a man whose brilliant and sound intellect, will place him on a high pinnacle of medical fame, observes, when treating of the use of calomel in yellow fever, that in serious cases he employs "not less than ℈j. at a dose, to be repeated every two, three, or four hours, and very often gives ℥ss. at the same intervals. My object," he says, "is to exhibit the maximum quantity of the medicine—the largest amount capable of acting remedially. On this principle I would not hesitate to administer an ounce at the dose if I thought that the stomach would bear it, and the system receive more readily its peculiar influences."‖ Let us analyse the action of mercurials and cathartics. They sometimes produce vomiting; they therefore irritate. They increase intestinal contraction; another proof that they irritate. They increase the secretions of the liver and mucous membrane; the constant effect of irritants. When given in excessive doses they acutely inflame the mucous membrane.¶ From these properties it may be determined whether they may be used with safety in gastro-enteritis. Many of the greatest authorities of both ancient and modern times have proved

* Begin's Therapeutics, Vol. II. p. 100, 1829.
† Heustis, in Amer. Journ. of Med. Sciences, for May, 1828, p. 40.
‡ Idem; also Orfila. § Heustis in the same, p. 41.
‖ Amer. Journ. of Med. Sciences, for May, 1828, p. 75.
¶ Murray's Materia Medica, 1824, p. 185.

that they cannot. Cathartics may cure gastro-enteritis by exciting free secretion from the inflamed surface; but cure is by no means a constant effect of this.* They may cure inflammation of the upper part of the canal by the revulsive irritations which they excite in the lower portions of the same, and vice versa. In the latter way do emetics sometimes cure dysentery. Both of these effects very often fail, and their chance of success diminishes with the severity of the disease, for when the inflammation reaches a certain point, the membrane refuses to secrete, and here the irritation produced in the lower intestine must amount almost to dysentery, before it can be a revulsion from the stomach, liver and small intestines. Who will venture such treatment, when he reflects that if his remedy fail to relieve, it will be seriously injurious? About three years since, we gave, in a case of acute gastro-enteritis, with much soreness of the epigastrium, a large dose of cream of tartar with jalap. The patient being an old lymphatic woman, and the inflammation confined almost entirely to the stomach and duodenum, a most fortunate revulsion took place, with large secretions, and in twenty-four hours the patient was well. This we explained on the ground of the removal of morbid matter from the blood, and some other hypothetical views which we are now forgetting. A few months since, the same patient experienced a similar attack of rather less severity. As the disease was moderate, and the temperament by no means nervous or sanguine, we gave at first three drachms of sulphur, and as this did not operate, we administered, rather carelessly, after a few hours, one drachm of the carbonate of magnesia. The consequence was six free operations, with rapid and dangerous congestion of the liver, which finally yielded to local bleeding, fomentations, mucilaginous drinks, and enemata. This case, which is but the type of thousands, shows us what faith we are to put in catharsis, as a means of cure in fever. We recollect the case of a young person of an irritable temperament, complaining of loss of appetite, bitter taste in the mouth, and head-ache, to whom we gave ten grains of calomel. In three hours it excited acute gastro-enteritis, which very nearly proved fatal; and a similar treatment being continued, the constitution received a shock, which, from present appearances, will, I am persuaded, never be entirely recovered. We readily make these confessions for the benefit of others, because, when a few years since, we made these errors, our reading had been confined to the then empirical works of our own language, and we had not corrected our errors by observation. Under our present

* Jackson, in Amer. Journ. of Med. Sciences, for Feb. 1828, p. 272.

impressions, a similar practice would be culpable, and we shall never follow it. Our friend from whom we have already quoted on the mercurial treatment of fever, says, "I saw no patient die salivated. I saw no case which was not surely and at once alleviated, as soon as ptyalism was brought on."* This is a very singular fact; for although Dr. Dickson's opportunities for observation have been far more extensive than our own, yet we know several cases of death from fever in Columbia, althongh free salivation was procured in all, and we have positive evidence of similar facts from several of our medical friends. There can be no error on the part of Dr. Dickson, for he is not a superficial observer, and chance is the only explanation we can give. We would add, that the negative evidence of this author, cannot, on philosophical principles, be opposed to our own positive facts. No physician who has not made the experiment, can form a just idea of the very small quantity of cathartic medicine required in the treatment of fever; and the only way to become fully sensible of the unnecessary and disadvantageous irritation which they excite is to observe the progress of cases treated without them. My observation of the comparative duration of summer and autumnal remittent fever, under the system of free purging, sudorifics, &c. and under that to which I shall soon proceed, will give about two and a half or three weeks for the former, and one for the latter; yet it will require further observation to determine this point exactly.

As we would not advocate the entire exclusion of laxatives from the treatment of fever, we shall state hereafter some cases in which we have used them with excellent effect.

Among the irritants used in the treatment of fever, sudorifics and substances supposed to be so, hold a conspicuous place. Emetic tartar in small doses, pulvis antimonialis, nitrate of potash, ipecacuanha, Dover's powder, and acetate of ammonia, are the most common. These medicines are of less value in gastro-enteritis, than those already mentioned. They may cure, or at least relieve gastro-enteritis, by exciting secretion and catharsis, as sometimes happens in the action of emetic tartar, pulvis antimonialis, and ipecacuanha; by transferring the irritation to a portion of membrane not inflamed; finally, by transferring it to the skin, and exciting perspiration. The objections urged against emetics and cathartics are applicable to these. When they act well they often fail to produce much impression upon the disease, and when they do not succeed in revulsion or secretion, they irritate a surface already inflamed, and generally increase the inflammation,

* Amer. Journ. of Med. Sciences, for May, 1828, p. 74.

drying and parching the tongue and skin, and producing nausea and head-ache. Nitre especially, is at once useless and injurious, and its use is common in proportion to its want of value. We have never been able to obtain any proof of its diaphoretic action, and we have no doubt that physicians have used it altogether on the authority of others, who themselves have taken their opinions from tradition. We have never known it to produce diaphoresis, or any other good effect in fever. It is much used as a refrigerant; those using the term having very indefinite ideas of its meaning in this instance. Its only advantage is, that it cools the water in which it is dissolved; but this is far more than counterbalanced by the impression which it exerts upon the inflamed membrane. Its well known effect, when given in large doses, is the production of intense gastro-enteritis, with bloody discharges.* It should be banished from the treatment of fever. Mild diaphoretics, given when a paroxysm is subsiding, sometimes induce perspiration with excellent effect; yet this result is by no means constant, and sometimes a contrary result is produced; so that this class of remedies is not applicable to many cases. The best mode of procuring perspiration is to remove that inflammation of the mucous membrane to which the dryness and heat of the skin are attributable; the skin will then often secrete spontaneously. When the mucous membrane is thus relieved, we will generally succeed in restoring perspiration by very mild diaphoretics, with little or no danger of producing any irritation; or if this arise it is trifling and easily removed. But so long as there is a gastric irritation of any importance, *i. e.* so long as there is decided fever, mild diaphoretics will usually fail, from want of activity, and those of a more active nature will also fail by irritating the stomach.

Our limits, and the nature of the present paper, will not allow us to consider more particularly the employment of irritants, but the intelligent reader will be able to extend for himself the principles already stated. We proceed to the proper treatment.

If the disease commence with very intense excitement of the circulatory organs, evinced by a rapid, full, and hard pulse, especially if the epigastrium be painful and swollen, or if there be intense head-ache, with injection of the face and eyes, the patient should be seated upright, and bled in a full stream from the arm, until the pulse becomes less violent. The capacity of the patient to bear this, must, however, always be kept in view. When there is active congestion of some important organ, the pulse, though often small, will fre-

* Paris's Pharmacologia, 1825, p. 452.

quently be corded, tense, and hard. Here the lancet is generally demanded, and may be used with tolerable freedom, especially if the pulse soften and dilate during the flow of blood. We have often been surprised at the unpardonable negligence of authors, in not giving proper cautions concerning the employment of the lancet in persons addicted to the use of alcoholic liquors. They bear the lancet less than any other class of patients; and it would, perhaps, be a good rule, to forbid it entirely in these cases; for though some patients will demand it, yet these are very rare, and still more rare are physicians who can recognise them. In fact, the question will often be beyond the reach of human sagacity. In an immense majority of fevers, the lancet is not proper; yet those cases in which it is safe and useful, are certainly more numerous in scattered and vigorous populations, than we would be led to expect, from the opinions of authors who have practised among the weakened constitutions of large and luxurious cities. We may content ourselves with these few observations on general bleeding, as it would require a volume to do justice to the subject, and such a volume is very much needed in our language.*

The writings of Dr. Currie,† and the useful analysis of his work published by Dr. Thacher, in his Dispensatory, have sufficiently familiarized the medical world with the great value of cold water, externally applied, in most cases of fever. Where it is not unpleasant to the patient, and where the heat is very intense, it may be used in the form of cold affusion; in other cases sponging may be employed; in either way the effect is excellent. If the skin be very moist during the fever, or if there be great debility from diarrhœa, this application is not safe.‡ As a general rule, it is not adapted to exanthematous fevers; but rosalia constitutes an exception.§ In cases in which for some hours after the commencement of a paroxysm, there is alternation of heat and chill, it should be avoided until the hot fit is fully established, though it may sometimes be used earlier with good effect as we have experienced.

The next step, and the most efficacious of all, is depletion from the epigastrium. The quantity of blood drawn must be regulated by the strength of the patient, and the character, intensity, and stage of the disease. It will be extremely rare for this depletion to fail in

* A translation of Poliniere's Emissions Sanguines Artificielles, would be valuable.

† Medical Reports on the Effects of Water, Cold and Warm, &c.

‡ First Amer. edition of Gregory's Theory and Practice, 1826, Vol. I, p. 73.

§ Idem, p. 231

producing a rapid and distinct alleviation of the disease. If the symptoms should rise again after the first local bleeding, the remedy is to be repeated according to circumstances. Certain states of prostration in typhus,* and of acute gastro-enteritis supervening upon a chronic form of the same disease,† counterindicate local bleeding: but the extent and importance of this subject obliges us to refer to other authorities. If there arise, in the course of the disease, symptoms of meningeal or cerebral irritation, as intense head-ache, delirium, tendency to stupor, subsultus tendinum, or extensive soreness of the skin, and the depletion from the epigastrium do not soon alleviate this condition, it will be proper to apply leeches along the carotids, to the temples, behind the ears, or to any part of the head which may be very painful.‡ Here, also, the application of cold to the head will be proper, if it be hot and not covered with perspiration. On the same principles we shall apply leeches to the region of the liver, if that organ be congested or inflamed, around the umbilicus if great thirst and soreness of that region indicate predominance of irritation in that part,§ and to the perinæum, hypogastrium, or course of the colon, if diarrhœa, dysentery, or other symptoms of irritation in the large intestines exist. If the fever be complicated with inflammation of the respiratory organs, leeches and emollients should be applied to the chest, and the drinks should not be so cold as in uncomplicated gastro-enteritis. The reader will find, in the writings of Broussais, Begin, Boisseau, and Goupil, those details on this subject, the possession of which is essential to every practitioner.

The application of emollient fomentations to the abdomen will be useful, as they have a considerable influence in calming the internal irritation, provided they be constantly used. If the abdomen be very hot, the fomentations may be cold, in fact ice water is sometimes applied to the epigastrium with great advantage. If the heat be moderate, they may be temperate or even tepid Their effect is always good, and often surprising.

During the course of the fever, the drinks should consist of cold water, pure, or acidulated with lime juice or tartaric acid, to which may be added white sugar. Mucilages, also, will be very useful, and they may be acidulated and sweetened as the water. They should be made from those substances of which but little is required to render the

* Goupil; Exposition des Principes de la Nouvelle Doctrine Médicale, 1824, p. 503.

† Idem. ‡ Bégin's Therapeutics, Vol. I. p. 191.

§ Translation of Martinet's Manual of Pathology, 1827, p. 118, 216.

drinks mucilaginous. Tragacanth is the best of the gums, and bene the most convenient and agreeable of the vegetables. All vegetable infusions of an aromatic or otherwise irritant nature, as well as solutions of animal matter, must be carefully avoided, as our object is to present to the digestive surface bland and debilitating fluids only.

Especial care must be taken throughout the disease, to avoid constipation, and this must be done with as little irritation as possible to the inflamed surface. Local depletion and fomentations will frequently effect this object, but it will often become necessary to employ enemata. These, at first, should be simple and unirritating, but when mild fluids fail to produce a proper effect, moderate quantities of cathartic substances may be added. It must be recollected that enemata cannot be employed when there is much irritation of the rectum. In almost all cases, the treatment above advised will keep the bowels sufficiently open, but in some cases enemata will fail to produce evacuations, and the costiveness will produce evident bad effect. Here, then, laxatives, if judiciously used, may be highly beneficial. If the tongue be red, pointed, and dry, or covered with a dark and cracked coat, and the skin dry and parched, with tension and pain of the abdomen, or other symptoms of very acute inflammation, these symptoms must be reduced by local bleeding, &c. before we can venture upon laxatives, which under these circumstances are very hazardous. When, however, the abdomen is soft, the heat moderate, and the tongue broad, moist, and merely furred, without much redness, the mildest laxatives, such as castor oil, magnesia, cooked prunes, and tamarinds, given in small quantities at moderate intervals will be eminently serviceable, especially if assisted by enemata. In no case is free purging proper.

If, during the progress of fever, the gastro-enteritis become complicated with cerebral irritation and congestion, not yielding to local depletion, we must resort to revulsives. If the patient be perfectly sensible, the irritation increasing rather than diminishing the general irritability, we must carefully avoid those revulsives which excite pain, as they are apt to increase the determination to the brain, and rekindle any febrile symptom which may have diminished. In these cases wrap the legs and thighs in blankets wrung out of hot water, and renew them as soon as they begin to cool. The legs may also be kept in hot water containing a sufficient quantity of mustard to stimulate moderately without causing pain. The application must be continued for many hours. When the brain becomes so much congested as to produce a diminution of sensibility, or even coma, pain is less easily excited, and stronger irritants may be employed. Sina-

pisms, ammonia, and the solution of cantharides in turpentine may be used, if the sensibility be sufficiently diminished. They may be applied to more or less extensive surfaces of the legs and thighs, and to the back of the neck. The greatest danger is in irritating the brain by pain.

The hot stage of intermittent fever is to be treated as already directed. Sulphate of quinine and other febrifuges are to be used in the intermission, and our great object is to render this as perfect as possible. In common intermittents, the tonic must not be used until all the febrile symptoms are dispersed, and the skin is cool, the pulse natural, and the tongue nearly clean and not too red. Before this, tonics are very apt to aggravate the paroxysms. The diet during the apyrexia must consist of vegetable solutions, as of barley, sago, and arrow root. It will rarely be safe to use tonics in the first interval of common intermittent, or at any period of moderate remittent. When, however, the disease is very malignant, and there is danger of death in the next paroxysm, we cannot depend on antiphlogistics alone, but must resort to the sulphate of quinine in the remission. If the stomach reject it, throw it into the rectum, and rub the skin with the tincture of bark. If there have been several paroxysms, and the pulse be small, feeble, intermittent, the skin livid or pale, and the patient senseless, avoid even local bleeding, apply to the legs and thighs the most rapid rubefacients, while a solution of several grains of sulphate of quinine is thrown into the rectum, and the skin is rubbed with the tincture of bark. The tonics are dangerous in these cases, but without them the danger is greater.

During convalescence from fever, all stimulants must be shunned as tending to renew the gastro-enteritis. The diet should consist, at first of the vegetable solutions above mentioned, and the return to common food should be very gradnal.

Our limits have allowed us to state the fundamental principles only of the treatment of malarial fever, and the authors of the physiological school must be consulted for more minute details.

From the present state of our knowledge of malaria, we think that the following conclnsions may be drawn:—

That malaria has exerted its influence on man and domestic animals* in all ages.

That it possesses properties different from those of volatile solids and liquids, as well as from those of animalculæ and uncombined gases.

* For its effects on domestic animals, see Chapter XI. of Macculloch.

That as it has not been obtained in an insulated state, and as its properties coincide exactly with those of that combination of water and carburetted hydrogen which arises from marshes, we may fairly conclude that they are identical.

That it acts primarily on the cutaneous and pulmonary surfaces, and that its effects may be prevented.

That the internal inflammations created by carburetted hydrogen should be treated by antiphlogistics, and not by irritants.

Columbia, S. C. January, 1830.

ART. IV. *Case of Fistulous Communication between the Vagina, Bladder, and Rectum.* By CHARLES BYRNE, M. D., U. S. Arsenal, near Baltimore.

ON the 18th of November, 1826, I was called to visit Mrs. M'K. in labour with her first child. The waters, I was informed, had been discharged before my arrival. On examination, I found the pelvis well formed. The os uteri had dilated to about the size of half a dollar, the vertex presenting. The woman had enjoyed good health during gestation, the pains were strong, and every symptom seemed to indicate a safe and speedy delivery. The head, however, advanced very slowly, and at the expiration of twenty hours had not entirely cleared the superior strait. At the end of ten hours more it was found presenting at the labia externa; but the pains had entirely subsided, and the patient seemed very much exhausted. The case now, for the first time, in my judgment, demanded the interference of art, and I accordingly proceeded to render assistance. By introducing the forefinger of the right hand into the child's mouth, and the other hand behind the occiput, it was extracted with little difficulty. The child was dead, and bore all the marks of severe compression. The bones of the cranium were firmly united, and would not yield to the strongest pressure between the hands, to which circumstance I must attribute the difficulty of the labour, and the melancholy effects which followed.

After trying every means for the space of an hour to promote the expulsion of the placenta, without success, I introduced my hand into the uterus, and found that viscus in the state which has been called the "hour-glass contraction." By following the cord, I found that the placenta was attached to the fundus uteri, and was of course confined